π^-/π^+ Ratios in $^2H(e,e'\pi^\pm)n_S(p_S)$

(E93021 & E01004)

- **Motivation**
- **Corrections and data analysis**
- **Outlook**

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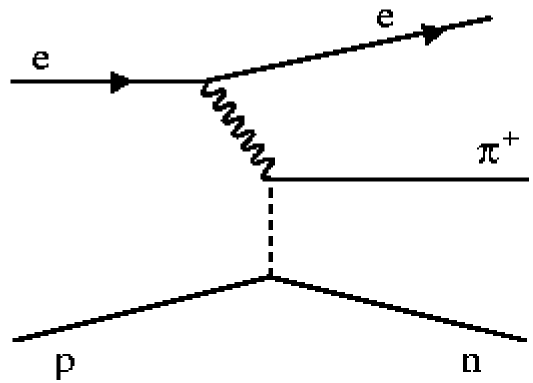
Hall C Collaboration Meeting, JLAB, January 25, 2007

Motivation



- Ratio $R = \frac{\sigma_L(\gamma_v n \to \pi^- p)}{\sigma_L(\gamma_v p \to \pi^+ n)} = \frac{|A_V - A_S|}{|A_V + A_S|} \to 1$ at low −t.

- Deviations of R from 1 would give indications of isoscalar background contributions in the longitudinal response.

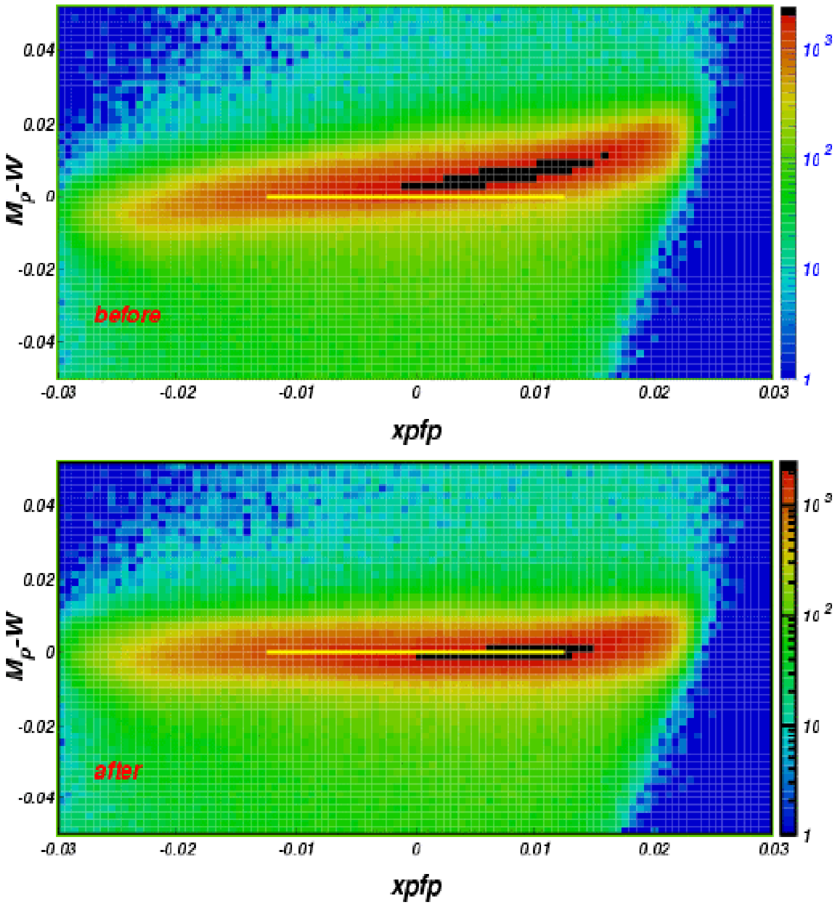
- Bring these data (Fpi1-E93021) to the current level (Fpi2-01004) of analysis.

- Fpi1(E93021) 2H data: Q2=0.6, 1.0 & 1.6 GeV2.
- Fpi2(e01004) 2H data: Q2=2.45 GeV2.

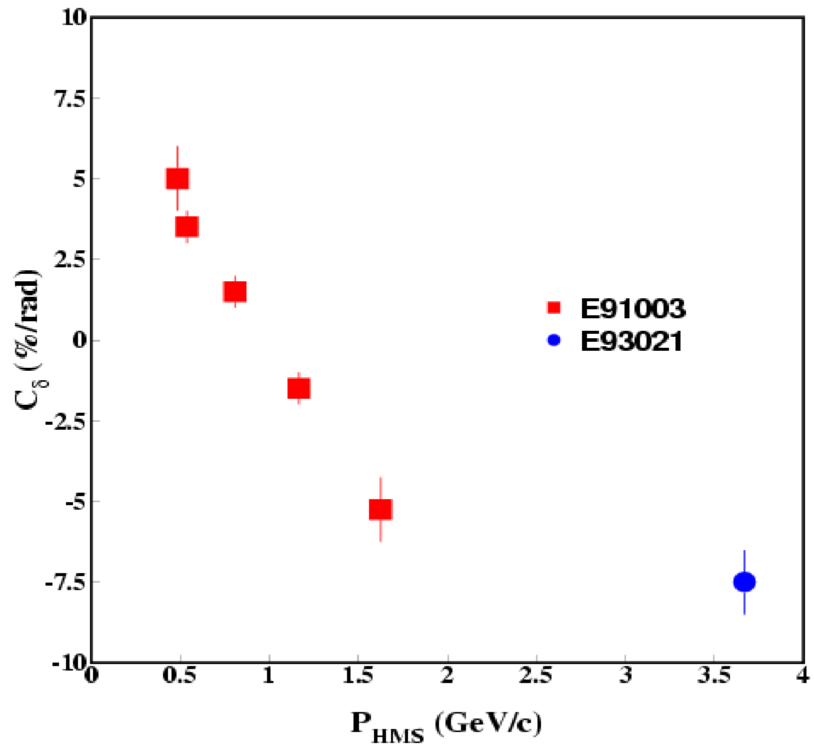
Corrections to Fpi1 data set

- Using the new tracking algorithm (new CVS engine) on the old data (E93021) we extend multitrack event capabilities and implicit a more accurate event reconstruction.
- SOS & HMS Delta/xpfp correlations are being corrected with a linear dependent function of form $\delta' = \delta + C_{\delta} \cdot x'_{fp}$.
- New wire chambers tracking efficiencies as a function of event rate are extracted.
- HMS Cerenkov blocking correction as a function of event rate.

HMS Q3 Corrections



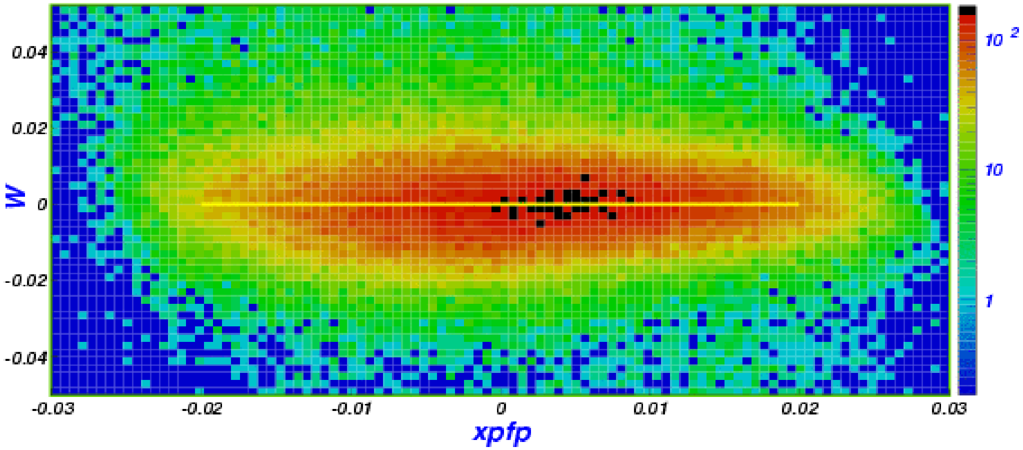
Old Q3/Dipole ratio



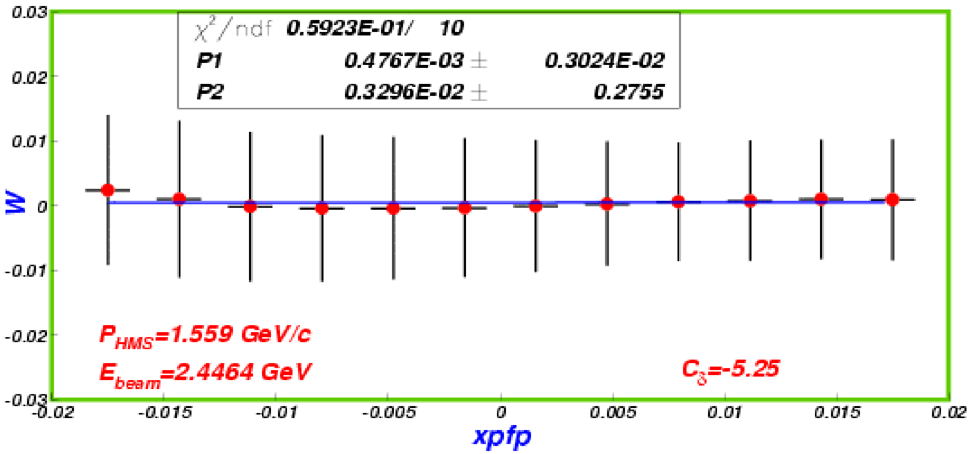
$$\delta_{HMS} = \delta_{HMS} + C_\delta * x'_{fp}$$

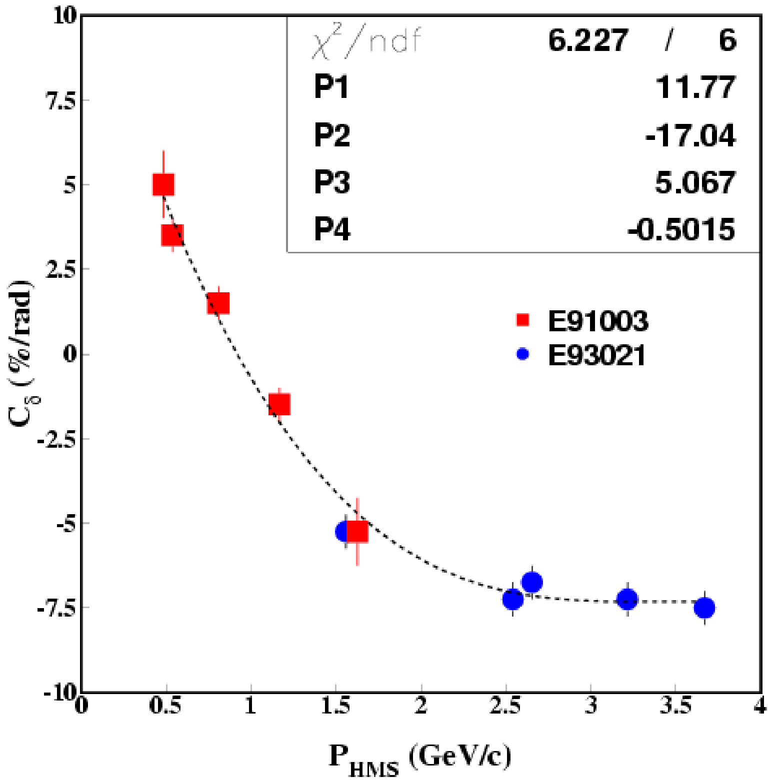
$$\delta_{HMS} = \frac{P - P_{HMS}}{P_{HMS}} * 100$$

HMS Q3 corrections



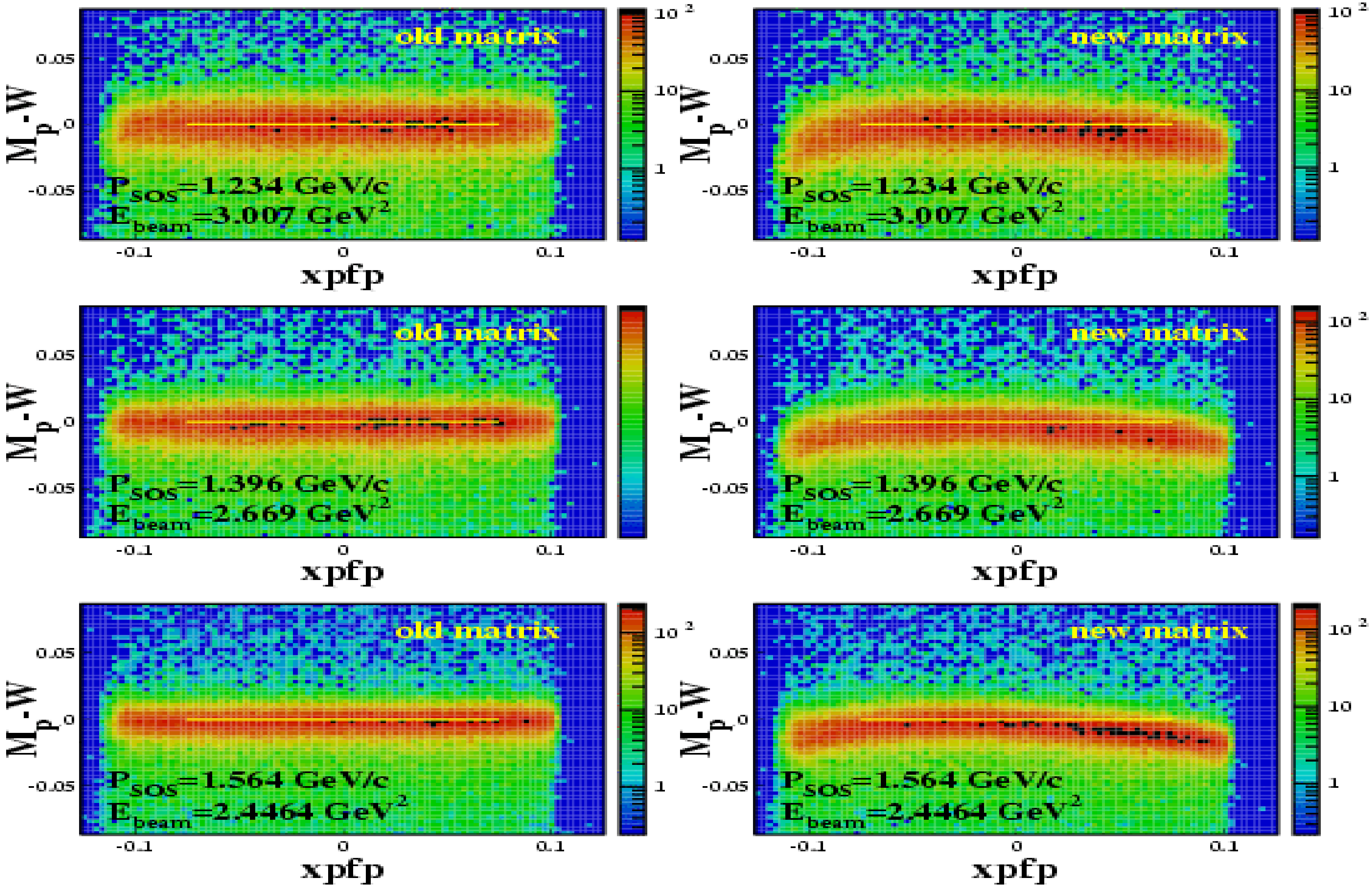
Using central HMS kinematics and detected proton momentum we reconstruct the invariant mass W (electron mass).





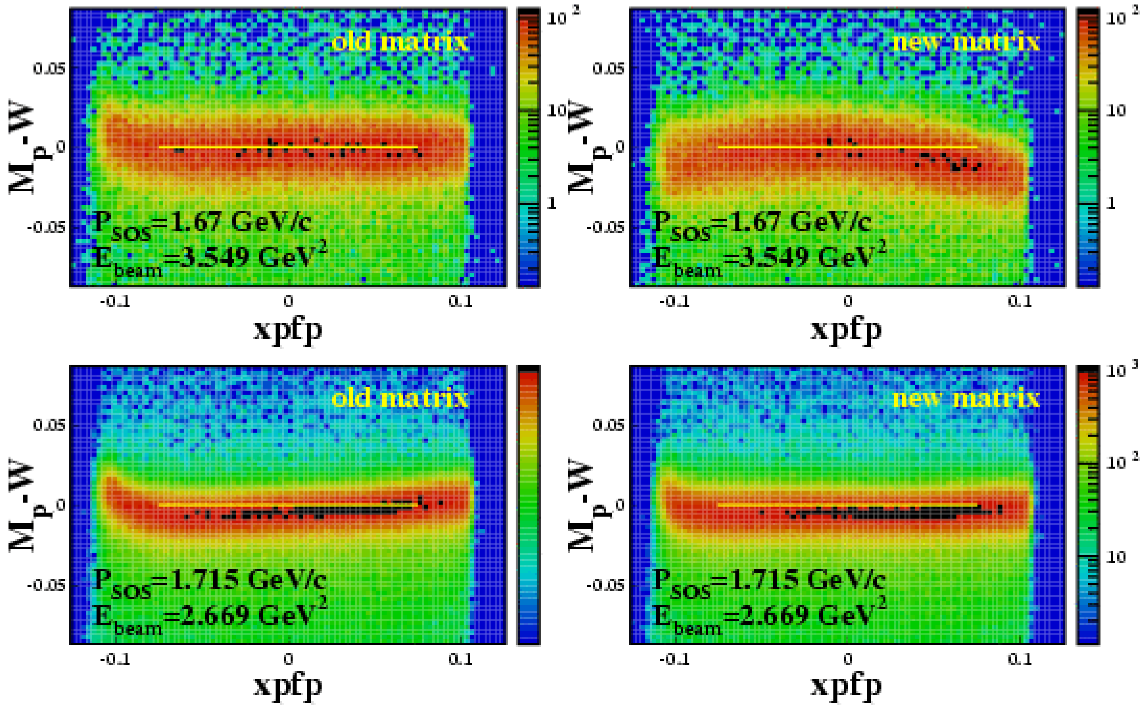
The W vs X' distribution was fitted with 1 degree polynomial.

SOS Q3 Corrections



1999 SOS optics matrix **2003 SOS optics matrix**

SOS Q3 Corrections



Low momentum (<1.6 GeV/c) – old settings & corrections works fine.

High momentum (>1.6 GeV/c) – use of new SOS optic matrix & new delta/xpfp correction.

Tracking Efficiency

$$\varepsilon_{tracking} = P_1 \cdot \varepsilon_1 + P_2 \cdot \varepsilon_2$$

$$P_2 \approx R \cdot \tau_{DC}$$

$$P_1 = 1 - P_2$$

$$\varepsilon_1 = 0.984$$

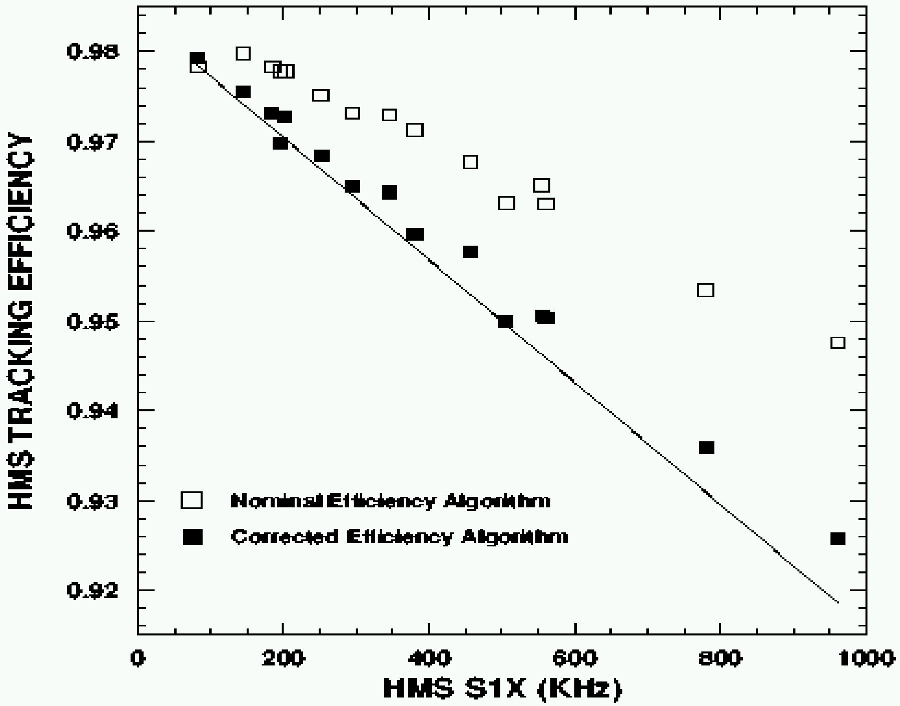
$$\varepsilon_2 = 0.71$$

τ_{DC} - DC gate width

R – DC rate

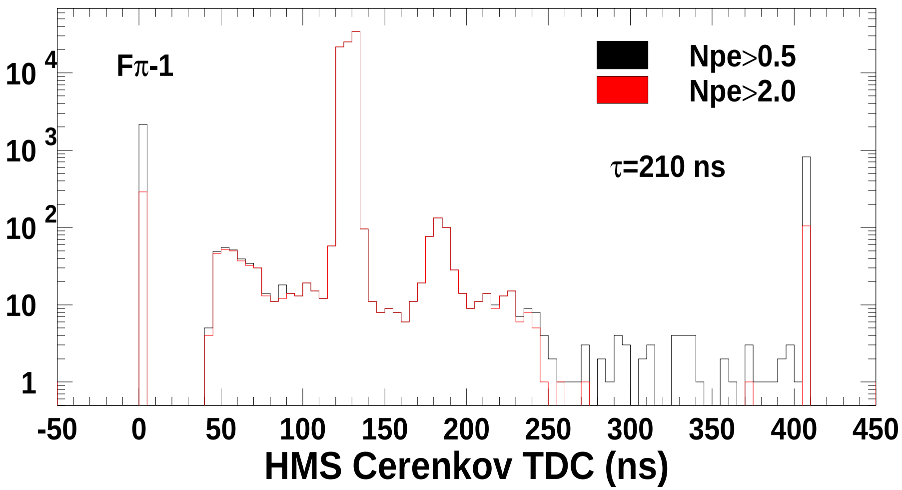
P_1 -single hit probability

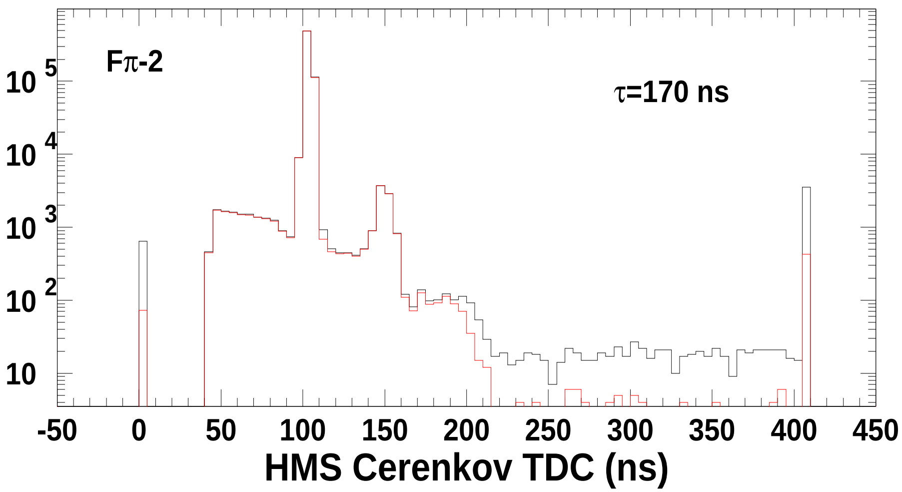
P_2 - multiple hits probability



Work is in progress !!!

HMS Cerenkov Blocking





HMS CC TDC spectrum for e

as identified by the HMS CC ADC

Using data taken with open trigger (el. & pions).

The TDC time window in Fpi1 is 23% larger than in Fpi2.

Use the Fpi2 data to fit the effective gate (same CC cut).

For npe<2.0 gate width – 190 ns.

Implies a larger correction in Fpi1 (18-20 % at 1MHz).

Significant impact in pi- (high rate) data.

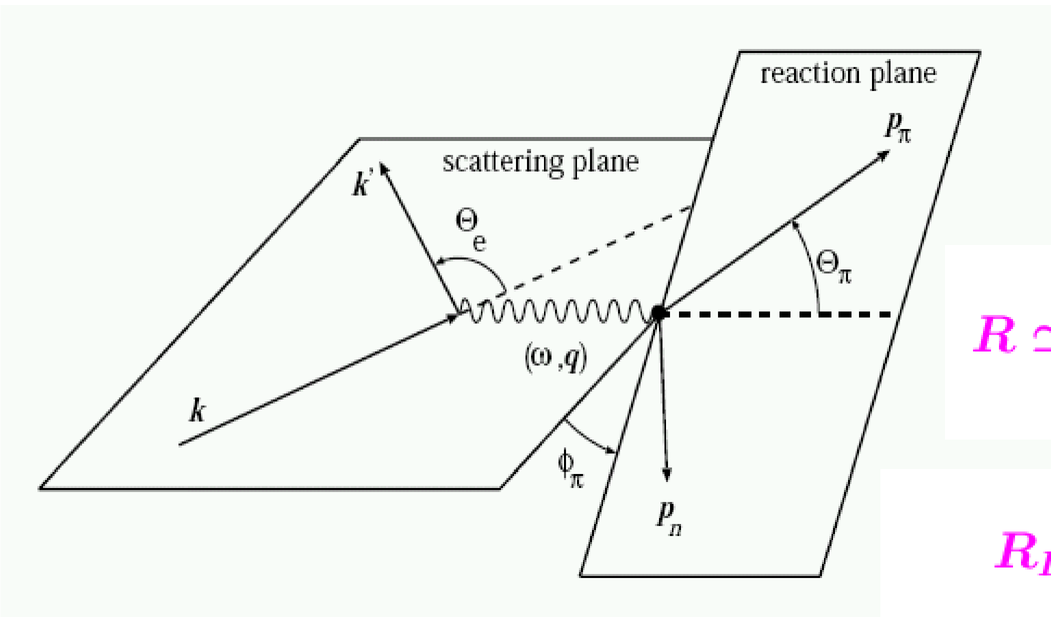
Interesting to see the level of uncertainties of this correction.

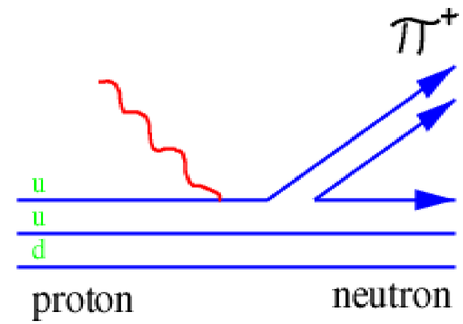
$$\varepsilon_{CC} = 1 - R_e \cdot \tau_{CC}$$

OUTLOOK

- Finish all the corrections to Fpi1 data set (CC blocking, Multiple tracking efficiency).
- Replay Fpi1 data set to generate ntuple used in the main analysis.
- Use Fpi1 and Fpi2 data sets to iterate Monte Carlo deuterium model.
- Extraction of σ_L , σ_T , σ_{LT} , σ_{TT} using L/T separation.
- Calculation of ratio $R = \dfrac{\sigma_L(\gamma_v n \to \pi^- p)}{\sigma_L(\gamma_v p \to \pi^+ n)}$.
- Publish the results. (this summer).

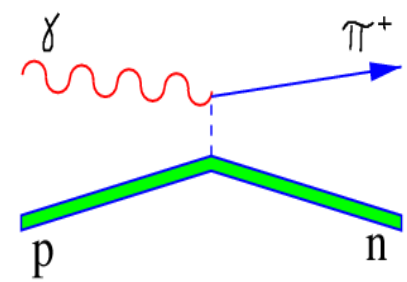
Kinematic Variables





$$R \simeq \frac{2Q_d^2}{2Q_u^2} = \frac{(-1/3)^2}{(+2/3)^2} = 1/4$$

$$R_L \simeq \frac{Q_{\pi^-}^2}{Q_{\pi^+}^2} = 1$$



$$t \equiv (\gamma_v - \pi)^2 = -Q^2 + m_\pi^2 - 2\nu E_\pi + 2\nu p_\pi cos\theta_{q\pi}$$

$$\frac{d\sigma}{dt} = \sigma_T + \epsilon\, \sigma_L + \epsilon \cos 2\phi\, \sigma_{TT} + \sqrt{2\epsilon(1+\epsilon)} \cos\phi\, \sigma_{LT}$$

$$\sigma_L \propto \frac{-2tQ^2}{(t - m_\pi^2)^2} \cdot g_{\pi NN}^2(t) \cdot F_\pi^2$$